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The fourth period, the present Soviet era, is marked by improvements on previously built locomotives and the construction of new, modern, and the most powerful locomotives in Europe.

In 1925, the Series S<sup>u</sup>, a passenger locomotive developed from the Series S, a high-speed passenger locomotive built by the Sormovo Plant in 1911, was built in the Soviet Union. The numerous changes which were made on this model, distinguishing it from the Series S, make it possible to consider it a new model and the first locomotive built by the Soviets.

The exceptional qualities of the Series S<sup>u</sup>, i.e., its high speed, comparatively high horsepower, and economy of operation make it one of the most outstanding locomotives in the world.

In 1931, Soviet locomotive engineers and builders constructed the Series FD, a powerful freight locomotive of Type 2-10-2. Following this, Soviet locomotive builders constructed a powerful high-speed passenger locomotive of Type 2-8-4 and named it the Series IS, after Iosif Stalin.

Further development of Soviet locomotive building is noted in 1934, with the building of new Model 2-10-0 type Series SO freight locomotives. Beginning with 1936, a considerable number of these locomotives have been equipped to utilize on exhaust steam. The last prewar passenger locomotives were the 4-6-4 models, designed for express trains.

At present, the Soviet Union is building the Series L main-line freight locomotive, developed from the Series SO, but with improvements which make it more powerful and more economical than its predecessor. The Series L is a completely modern locomotive.

#### Main Series of Soviet Locomotives and Their Features

Soviet locomotives can be divided into three principle groups. To the first group belong the low-horsepower locomotives built during the end of the past century and in the early 1900s. This group includes the Series O, Shch, Ts, and Y freight locomotives and the Series K, B, N, Z, G, and U<sup>u</sup> passenger locomotives. Few of the older series remain any more, while the Series D, Sh A, and P are no longer even considered part of the inventory.

The second group, made up of Series Ye and E freight locomotives of average horsepower and series K<sup>u</sup>, L<sup>p</sup>, M, S, and S<sup>u</sup> passenger locomotives, was built in 1912 - 1930.

To the third group belong the recently built and more modern locomotives, i.e., those built after 1930. In this group are the Series FD, SO, Sh<sup>a</sup>, and L, all freight, and the Series IS, a passenger locomotive.

#### Freight Locomotives

The O-8-0 Series O, built in 1891 - 1901, is a two-cylinder compound locomotive operating on saturated steam. The letter O is derived from the Russian word "osnovnoy" (principal). Because of certain structural features, locomotives of this series are distinguished by the following index letters:

- <sup>d</sup>  
O - equipped with Joy gears
- <sup>v</sup>  
O - equipped with Walschaerts gears
- <sup>p</sup>  
O - single expansion engine operating on superheated steam

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- <sup>k</sup>  
0 - made by Kolomna Plant, with improvements in steam distribution
- <sup>ch</sup> <sup>v</sup>  
0 - a modified 0 two cylinder locomotive operating on superheated steam (1), built in 1929.(2)

The 2-8-2 Series Shch, built in 1907, is a two-cylinder compound locomotive which operates on saturated steam. It was designed by Professor Shchukin, from whom it derives its name. There are different models of this series.

The 0-8-0 Series Y and Y<sup>ch</sup> are low-horsepower compound locomotives. The former operates by means of saturated steam and the latter by means of superheated steam. Built in 1910 - 1912, these locomotives were not used extensively because of their insufficient horsepower. The Series Y<sup>ch</sup> was noted for its economy of operation.

The 2-10-0 Series Ye is a two-cylinder, single expansion type freight locomotive operating on superheated steam.(1) The series was ordered from the USA in 1915 - 1917 and 1943 - 1944. Because of modifications made on each order, the Series Ye is subdivided by various index letters in order to distinguish the different models. The Series Ye<sup>f</sup>, No 1-27 and 36-250, a total of 242 locomotives, was built by the Baldwin Locomotive Works, Philadelphia, Pennsylvania, from which city the series derives its index letter f. The series Ye<sup>s</sup>, No 251-350 and 401-406, a total of 106 locomotives, was built by the American Locomotive Company, Schenectady, N. Y., in 1915 - 1916 (hence the letters s). The series Ye<sup>k</sup>, No 351-400, a total of 50 locomotives, was built by the Canadian Locomotive Company, Kingston, Ontario (hence the letter k).

The Series Ye<sup>l</sup>, No 501-925 and 1126-1175, a total of 475 locomotives, was built by the Baldwin Works and the American Locomotive Company in 1916 - 1917. These locomotives incorporated modifications developed by A. I. Lipets, hence the letter l. Because of the relatively poor steam superheating qualities of the Series Ye built in 1915 - 1917, the superheater heating surface of the locomotives ordered in 1943 was increased from 61.3 to 70 square meters. Stoker firing was also introduced, which gave the locomotive a capacity of a 2,300 horsepower. Locomotives of this series built in 1943 - 1944 carry the index letter a (American).(2)

The 0-10-0 Series E, a single expansion type locomotive operating on superheated steam and having a pressure of 12 atmospheres, is the most extensively used two-cylinder freight locomotive of average horsepower. Not too complex in construction, simple to service and repair, and economical to operate, this series has been used extensively on Soviet railroads. The first locomotives of this series were put into service in 1912. Since 1926, locomotives of this series have been equipped with powerful superheaters (1), and the weight on drivers was increased to 84 tons. These modifications resulted in the Series E<sup>u</sup>, the index letter u (usilenny) meaning strengthened.(2)

The Series E<sup>u</sup> locomotives were improved further in 1931 and were designated the Series E<sup>m</sup>. the m (modernizirovanny) meaning modernized. The improved locomotives have a boiler pressure of 14 atmospheres. Because of the increase in pressure, the running gear was strengthened to accommodate this increase. Despite the increased weight of the running gear, the over-all weight was somewhat less because of the change made in replacing the copper firebox with one of welded steel construction and because of the absence of a water heater. This slight reduction in weight on drivers, along with an increase in pressure on the piston, caused frequent slipping of these locomotives. The desire to eliminate this deficiency made it necessary to alter the boiler, which resulted in an enlarged firebox.(1) As a result, in 1934 (2) the fire grate area was increased from 4.46 to 5.09 square meters on the remaining locomotives with this index letter. Therefore, the boilers became more powerful and heavier,

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frequently eliminating the deficiency of weight on drivers of the Series E<sup>m</sup>. These reconstructed locomotives were designated with the index letter r and were named the series E<sup>r</sup>.(1)

The 2-10-2 Series FD (Feliks Dzerzhinskiy) (2) is designed for heavy duty at increased speeds over main lines. This series is fired by stoker.(1) Construction of this series began in 1931 at the Voroshilovgrad Locomotive Building Plant imeni Oktyabr'skaya Revolyutsiya. Designed to burn low-quality coal containing a high ash content (2), the locomotive has a radial firebox with a fire grate area of 7.04 square meters.(1) Its capacity is double that of the Series E<sup>u</sup>. The locomotive is capable of pulling train loads 40 percent heavier than the Series S<sup>u</sup>. Many of the parts of the boiler and engine of the FD are interchangeable with those of the Series IS.(2)

The first model of the 2-10-0 Series SO locomotive was built by the Khar'kov Locomotive Building Plant in 1934 and is a modification of the Series E.(2) The SO is a two-cylinder, single expansion type locomotive operating on superheated steam. Because of its larger boiler and fire grate area, which is 6 square meters, the locomotive has more capacity and more speed than the Series E. Also, it has a two-wheel truck to support the front end and to give it greater security in rounding curves at high speeds.(1) The SO<sup>r</sup>, a later model of this series, is equipped with a flue gas suction pump and a feed water heater.(2)

The Series SO<sup>k</sup>, a development from the Series SO, is equipped with a condenser. Operating on condensed exhaust steam, it is capable of making runs up to 1,000 kilometers or more without taking on additional water. Thus it is able to operate in localities where the water supply is scarce or in sections having hard water. Construction of these locomotives was started in 1935.(1)

The 2-8-0 Series Sh<sup>a</sup> is a two-cylinder, single expansion type freight locomotive built in 1943 in the United States. In order to economize in both material and labor, considerable simplifications were introduced into its construction. Built for service on railroads near the front lines during World War II, the series is operating satisfactorily on USSR railroads.(2)

A development from the Series Ye, the Series Ye<sup>a</sup> was built in 1944. It is equipped with a stoker and an air reverse gear for varying the cutoff and changing the locomotive's speed. Most recent models of the Ye<sup>a</sup> have been modified and are named the Series Ye<sup>m</sup>.

The 2-10-0 Series L, designed for main-line service, is a high-speed, two cylinder, single expansion type locomotive operating on superheated steam. Designed and built by the Kolomna Plant, it is noted for its economy and originality of construction. The series was named L after its designer, Engineer L. S. Lebedyanskiy.

#### Passenger Locomotives

The 4-6-0 Series G, built in 1901, is a two-cylinder single expansion type passenger locomotive operating on saturated steam. The G<sup>p</sup> operates on superheated steam.

The 2-6-0 Series N, built in 1903, is an old two-cylinder compound type locomotive operating on saturated steam. There are several modifications of this series, each designated by an index letter.

The 4-6-0 Series K, built in 1910 - 1911 is a two-cylinder single expansion type locomotive operating on superheated steam. The K stands for the Kolomna Plant, where it was built.

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The Series K<sup>u</sup>, developed from the Series K, is a more powerful locomotive, having a pressure of 13 atmospheres instead of 12, a wheel diameter of 1,900 millimeters instead of 1,700 millimeters, and a larger heating surface. The fire grate area is 3.14 square meters instead of 2.72 square meters.

The 4-6-0 Series U and U<sup>u</sup>, built in 1907 - 1912 and first put into service on the Ryazan'-Ural', Railroad, is a high-speed, four-cylinder compound type locomotive. The U operates on saturated steam and the U<sup>u</sup> operates on superheated steam. At present, there are few of these locomotives in service.

The 4-6-0 Series B, named after the Bryansk Plant where it was built in 1908, is a two-cylinder locomotive which operates on superheated steam.

The 2-6-2 Series S, designed to use coal (2), is a high-speed two-cylinder single expansion type locomotive operating on superheated steam. It is named after the Sormovo Plant, where it was designed and built in 1911. Of comparatively high horsepower, simple in construction, and not too complex to service and operate (1). This series was used widely on Russian railroads from 1913 to 1917.(2)

The 4-6-2 Series L<sup>P</sup> is a fast-service four-cylinder single expansion type locomotive which operates on superheated steam. Built in 1915 by the Putilov (at present Kirov) Plant, the locomotive has four engines, two of them internal. In addition, the locomotive has a double-crank axle arrangement on its drivers.(1) Construction of these locomotives was resumed in 1923. They are most adapted for high speed on level terrain with heavy passenger trains. Because of the weakness of the double-crank axle and the inclination to skid, utmost care of this axle and of the spring rigging is required. Because of its complexity, the Series L<sup>P</sup> has not been used extensively.(2)

In production since 1925, the Series S<sup>u</sup> is a development from the Series S. It is a fast service locomotive of average capacity. Operating on superheated steam and having a more powerful superheater than the Series S. It is noted for its high economy. Also, it has a greater boiler capacity than the Series S.(1) The main features of the S<sup>u</sup> are its increased pressure of 13 atmosphere, relatively small expenditure of steam per unit of power, adaptability of the boiler to work on low-grade coal, and high degree of security in rounding curves at high speeds. It is the most extensively used passenger locomotive on Soviet railroads.(2)

The Series S<sup>um</sup> is a modification of the Series S<sup>u</sup>. It has a blower, steam air heater, and a feed water heater. Construction of this series was begun in 1938.(1) However, with the present-day increase in the weight of passenger trains, neither the S<sup>u</sup> nor the S<sup>um</sup> have sufficient weight on drivers with an axle load of more than 18 tons.(2)

The 4-8-0 Series M, built in 1926 - 1933, is a three-cylinder locomotive.(1) It had a number of defects, such as frequent skidding, a firebox which was not well proportioned to the engine, and an uneven stroke of the piston rod of the middle cylinder. Converted in 1933 - 1934 into a two cylinder locomotive, and with the pressure increased from 13 to 14.5 atmosphere, the improved model was named the series M<sup>F</sup>.(2)

The first IS, named after Iosif Stalin (1), was built by the Kolmna Plant in 1932.(2) In production at the Voroshilovgrad Plant since 1937, the 2-8-4 Series IS is a two-cylinder locomotive designed for fast service with heavy passenger trains over main lines.(1) Its capacity is double that of the S<sup>u</sup> and its speed 1.5 times that of the S<sup>u</sup>. Whereas the S<sup>u</sup> is able to pull trains of

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360 tons at a speed of 100 kilometers an hour, the Series IS is capable of pulling 700-ton trains. It is the most powerful locomotive in Europe today.(2) In principle, this locomotive is similar to the Series FD, the boiler and some parts of the engine being interchangeable.(1)

## SOURCES

1. Parovoz (Locomotive), P. A. Skepskiy. Transzheldorizdat, Moscow, 1950, pp 4-6, 9-18
2. Tekhnicheskiy Zheleznodorozhniy Slovar' (Technical Railroad Dictionary) second edition, B. N. Vedenisov, et. al., Transzheldorizdat, Moscow, 1946

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